

## X-RAY IMAGING DEVICE AND X-RAY IMAGE FORMING METHOD

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation application of U.S. application Ser. No. 14/017,480 filed Sep. 4, 2013, which claims priority from Korean Patent Application No. 10-2012-0098185 filed on Sep. 5, 2012, in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference in their entireties.

### BACKGROUND

[0002] 1. Field

[0003] Apparatuses and methods consistent with exemplary embodiments relate to generating an X-ray image which clearly distinguishes the internal tissues of the object.

[0004] 2. Description of the Related Art

[0005] An X-ray imaging device generates images of an inner structure of an object by radiating X-rays to the object and analyzing X-rays passing through the object. X-ray transmittance varies depending on internal substances of the object, and an image of the inner structure of the object is acquired using an attenuation coefficient indicating transmittance as a numeric value.

[0006] In recent years, in order to increase a contrast between internal tissues of the object, a great deal of research has been conducted, and a method for acquiring X-ray images from a plurality of X-rays having different energy levels has been proposed.

### SUMMARY

[0007] Exemplary embodiments may address at least the above problems and/or disadvantages and other disadvantages not described above. Also, the exemplary embodiments are not required to overcome the disadvantages described above, and an exemplary embodiment may not overcome any of the problems described above.

[0008] One or more of exemplary embodiments provide an X-ray imaging device to produce at least one of a single energy X-ray image and a multiple energy X-ray image depending on characteristics of an object, and a method for producing an X-ray image.

[0009] In accordance with an aspect of an exemplary embodiment, an X-ray imaging device includes an X-ray generator to generate X-rays and radiate the X-rays to an object, an X-ray detector to detect the X-ray passing through the object and acquire an image signal of the object, and a controller to evaluate a characteristic of the object based on the image signal and produce at least one of a single energy X-ray image and a multiple energy X-ray image according to the evaluated characteristic.

[0010] In accordance with an aspect of an exemplary embodiment, a method for producing an X-ray image includes: radiating an X-ray to an object; detecting the X-ray passing through the object and acquiring an image signal of the object, analyzing the image signal to evaluate a characteristic of the object, and producing at least one of a single energy X-ray image and a multiple energy X-ray image according to the evaluated characteristic.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The above and/or other aspects will become more apparent by describing certain exemplary embodiments, with reference to the accompanying drawings, in which:

[0012] FIG. 1 is a block diagram illustrating a configuration of an X-ray imaging device according to an exemplary embodiment;

[0013] FIG. 2 illustrates an overall appearance of an X-ray imaging device to image breasts according to an exemplary embodiment;

[0014] FIG. 3 is a sectional view illustrating a tissue composition of a breast;

[0015] FIG. 4 is a block diagram illustrating an X-ray imaging device according to an exemplary embodiment in detail;

[0016] FIG. 5 is a graph showing energy bands of an X-ray radiated from the X-ray imaging device;

[0017] FIG. 6 is a graph schematically showing variation in attenuation coefficient of X-rays, with respect to individual substances constituting the human body;

[0018] FIG. 7 is a block diagram illustrating a configuration of an X-ray imaging device according to an exemplary embodiment;

[0019] FIG. 8 is a circuit view illustrating a portion of the photon counting detector (PCD);

[0020] FIG. 9 is a block diagram illustrating an X-ray imaging device according to an exemplary embodiment;

[0021] FIGS. 10A and 10B illustrate an example of an image displayed on a display;

[0022] FIG. 11 is a flowchart illustrating a method for producing an X-ray image according to an exemplary embodiment;

[0023] FIG. 12 is a flowchart illustrating a method for producing an X-ray image according to an exemplary embodiment;

[0024] FIG. 13 is a flowchart illustrating a method for producing an X-ray image according to an exemplary embodiment;

[0025] FIG. 14 is a flowchart illustrating a method for producing an X-ray image according to an exemplary embodiment; and

[0026] FIG. 15 is a flowchart illustrating a method for producing an X-ray image according to an exemplary embodiment.

### DETAILED DESCRIPTION

[0027] Certain exemplary embodiments are described in greater detail below with reference to the accompanying drawings.

[0028] In the following description, the same drawing reference numerals are used for the same elements even in different drawings. The matters defined in the description, such as detailed construction and elements, are provided to assist in a comprehensive understanding of exemplary embodiments. Thus, it is apparent that exemplary embodiments can be carried out without those specifically defined matters. Also, well-known functions or constructions are not described in detail since they would obscure exemplary embodiments with unnecessary detail.

[0029] FIG. 1 is a block diagram illustrating a configuration of an X-ray imaging device.

[0030] Referring to FIG. 1, the X-ray imaging device or the X-ray imaging apparatus 100 includes an X-ray genera-